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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/695,160	10/29/2003	Howard E. Rhodes	M4065.0939/P939	7143

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EXAMINER	
HO, TU TU V	

ART UNIT	PAPER NUMBER
2818	

DATE MAILED: 05/17/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/695,160	RHODES, HOWARD E.	
	Examiner	Art Unit	
	Tu-Tu Ho	2818	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 February 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-14,17,18,20,22-25,30-37,40,43-50 and 235* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-10,12,17,18,20,22-25,30-37,40,43-47 and 235* is/are rejected.

7)☒ Claim(s) *5,11,13,14 and 48-50* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *23 February 2006* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 02/23/2006 has been entered.

Claim Objections

2. **Claim 5** is objected to because of the following informalities: Claim 5 recites: "wherein said third sub-region has no dopant from said first and second doped sub-regions and separates said first and second doped regions from said charge accumulation region", wherein "said first and second doped regions" clearly derives an antecedent basis from said first and second doped **sub**-regions. Therefore, change "said first and second doped regions" to "said first and second doped sub-regions".

Appropriate correction is required.

Claim Rejections - 35 USC § 102

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

3. **Claims 1-6, 12, 20, 30-33, 35, and 235** are rejected under 35 U.S.C. 102(e) as being anticipated by Coffa et al. U.S. Patent Application Publication 20020185700 (the '700 reference).

The '700 reference discloses in Figs. 3-4 and respective portions of the specification a photoconversion device as claimed.

Referring to **claim 1**, the '700 reference discloses a photoconversion device (photodiode) comprising:

a substrate (that is generally indicated at 5, Fig. 3) having a surface;

a doped region (13) in said substrate and at said surface thereof, said doped region being of a first conductivity type (p) and having a graded profile (see Fig. 4), wherein said doped region has a higher dopant concentration near the surface of the substrate (as best visualized from both Figs. 3 and 4, where axis d of Fig. 4 clearly represents the depth of the photoconversion device depicted in Fig. 3, and axis D the dopant profile, paragraph [0028]); and

a charge accumulation region (generally indicated at 19, paragraph [0030]) in said substrate and substantially below said doped region, said charge accumulation region being of a second conductivity type (n, "doped with erbium", paragraph [0026]; and note that although the reference does not explicitly erbium ions constitute an n-type conductivity type, erbium ions constitute an n-type conductivity type. See, for example, U.S. Patent 5,580,663, col. 2, lines 40-45).

Referring to **claim 2**, the reference further discloses that said first conductivity type is p-type, as noted above.

Referring to **claim 3**, the reference further discloses that said second conductivity type is n-type, as noted above.

Referring to **claims 4 and 12**, because the reference's doping profile for said doped region 13 is continuous (see Fig. 4), it is fair to conclude that said doped region further comprises (at least) a first sub-region doped to a first dopant concentration and (at least) a second sub-region doped to a second dopant concentration; and furthermore, said graded profile (established by said first dopant concentration and said second dopant concentration) is established by said first dopant concentration (nearer the surface of the substrate) being greater than said second dopant concentration as recited in claim 12.

Referring to **claims 4 and 20**, because the reference's doping profile for said doped region 13 is continuous (see Fig. 4), it is fair to conclude that said doped region further comprises (at least) a first sub-region doped to a first dopant concentration and (at least) a second sub-region doped to a second dopant concentration; and furthermore, said second doped sub-region (that portion of doped region 13 that is closer to said substrate surface) has a shallower doping profile with respect to said substrate surface than said first doped sub-region as recited in claim 20.

Referring to **claim 5**, the reference further discloses a third sub-region (18 or 14) adjacent to said first and second doped sub-regions, wherein said third sub-region has no dopant from said first and second doped sub-regions and separates said first and second doped sub-regions from said charge accumulation region.

Referring to **claim 6**, the reference further discloses that said first dopant concentration (such as p+, Fig. 4) is a p+ dopant concentration.

Referring to **claim 30** and using the same reference characters, interpretations, and citations as detailed above for claim 1 where applicable, the reference discloses a photoconversion device comprising:

a substrate (that is generally indicated at 5, Fig. 3) having a surface and a substrate dopant concentration (N-);

a first region (13) of said substrate, said first region being doped to a first conductivity type (p) and at least partially located at the surface of the substrate;

a second region (18) of said substrate, said second region being adjacent to said first region, said second region having a dopant concentration (N-) substantially the same as said substrate dopant concentration (N-, paragraph [0026]); and

a third region (19) of said substrate, said third region being doped to a second conductivity type (n) located substantially beneath said first region with respect to said substrate surface, separated from said first region by said second region, and being configured to collect photogenerated charge.

Referring to **claim 31**, the reference further discloses that said first conductivity type is p-type, as noted above.

Referring to **claim 32**, the reference further discloses that said second conductivity type is n-type, as noted above.

Referring to **claim 33**, the reference further discloses that said first doped region (13) has a first dopant concentration (p+).

Referring to **claim 35**, the reference further discloses that said first dopant concentration (p+) is a p+ dopant concentration.

Referring to **claim 235** and using the same reference characters, citations, and interpretation as detailed above for claims 1 and 30 where applicable, the reference discloses a photoconversion device comprising:

a substrate (5) having a surface and a substrate dopant concentration (N-);

a first region (13) of said substrate doped to a first conductivity type and located at and below the surface of the substrate, said region having a dopant gradient profile wherein said dopant is in higher concentration nearer said surface of said substrate relative to portions of said first region deeper within said substrate;

a second region (19) of said substrate doped to a second conductivity type (n) located substantially beneath said first doped region relative to said surface, said second region being configured with said first region for generating charge from light exposure and collecting photogenerated charges; and

a third region (18) of said substrate, said third region having a dopant concentration (N-) substantially the same as said substrate dopant concentration (N-, paragraph [0026]), separating said first (13) and second (19) regions from each other.

4. **Claims 1-4, 12, 20, and 24** are rejected under 35 U.S.C. 102(b) as being anticipated by Sin U.S. Patent 5,962,882 (the '882 reference, cited in a previous office action).

The '882 reference discloses in Fig. 4 and respective portions of the specification a photoconversion device as claimed.

Referring to **claim 1**, the '882 reference discloses a photoconversion device (photodiode) comprising:

a substrate (that is generally indicated at 70, Fig. 4) having a surface;

a doped region (82/76) in said substrate and at said surface thereof, said doped region being of a first conductivity type (p) and having a graded profile (p+ and p), wherein said doped region has a higher dopant concentration (p+) near the surface of the substrate; and

a charge accumulation region (generally indicated at 74) in said substrate and substantially below said doped region, said charge accumulation region being of a second conductivity type (n).

Referring to **claim 2**, the reference further discloses that said first conductivity type is p-type, as noted above.

Referring to **claim 3**, the reference further discloses that said second conductivity type is n-type, as noted above.

Referring to **claims 4 and 12**, the reference further discloses that said doped region (82/76) comprises a first sub-region (82) doped to a first dopant concentration (p+) and a second sub-region (76) doped to a second dopant concentration (p); and furthermore, said graded profile (established by said first dopant concentration and said second dopant concentration) is established by said first dopant concentration (p+) being greater than said second dopant concentration (p) as recited in claim 12.

Referring to **claims 4 and 20**, the reference further discloses that said doped region (82/76) comprises a first sub-region (76) doped to a first dopant concentration (p) and a second sub-region (82) doped to a second dopant concentration (p+); and furthermore, said second doped sub-region (82) has a shallower doping profile with respect to said substrate surface than said first doped sub-region (76) as recited in claim 20.

Referring to **claim 24**, the reference further discloses that said photoconversion device is part of a CCD imager (col. 1, lines 1-7).

5. Claims 1-6, 12, 20, 30-33, 35, and 235 are rejected under 35 U.S.C. 102(e) as being anticipated by Mori et al. U.S. Patent 6,521,925 (the '925 reference).

The '925 reference discloses in the figures, particularly Fig. 6 and respective portions of the specification a photoconversion device as claimed.

Referring to **claim 30**, the '925 reference discloses a photoconversion device (photodiode) comprising:

a substrate (20, Fig. 6) having a surface and a substrate dopant concentration (p);

a first region (25) of said substrate, said first region being doped to a first conductivity type (p+) and at least partially located at the surface of the substrate;

a second region (no number, generally defined by a region separating said first region 25 and region 21) of said substrate, said second region being adjacent to said first region, said second region having a dopant concentration (p) substantially the same as said substrate dopant concentration (p); and

a third region (21a/21b) of said substrate, said third region being doped to a second conductivity type (n) located substantially beneath said first region with respect to said substrate surface, separated from said first region by said second region, and being configured to collect photogenerated charge.

Referring to **claim 31**, the reference further discloses that said first conductivity type is p-type, as noted above.

Referring to **claim 32**, the reference further discloses that said second conductivity type is n-type, as noted above.

Referring to **claim 33**, the reference further discloses that said first doped region (25) has a first dopant concentration (p+).

Referring to **claim 34**, the reference further discloses that said second region has a dopant concentration of said first conductivity type (p) no greater than a dopant concentration (p) of non-active portions of said substrate (20).

Referring to **claim 35**, the reference further discloses that said first dopant concentration (p+) is a p+ dopant concentration.

Referring to **claims 43-44**, the reference further discloses that said photoconversion device is part of a CMOS imager, and that said CMOS imager is a 4T device (where T is transistors, Fig. 5).

Referring to **claim 46**, the reference further discloses that said third region (21a/21b) of said substrate comprises phosphorous ions (col. 10, lines 14-50).

Referring to **claim 47**, the reference further discloses that said second region of said substrate separates said first region (25) from a neck (generally indicated at 21b) of said third region (21a/21b).

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

6. **Claims 7-10, 17-18, 36-37, and 40** are rejected under 35 U.S.C. §103(a) as being unpatentable over Coffa et al. U.S. Patent Application Publication 20020185700 (the '700 reference).

Referring to **claims 7-8**, the '700 reference discloses said first dopant concentration according to the embodiment of Fig. 4 and as detailed above for claim 4, and although the reference does not disclose a specific range of dopant concentrations as claimed, selecting such a range of dopant concentrations for said first dopant concentration would be within the routine skill of one of ordinary skill in the art at the time the invention was made, therefore, such selecting would have been obvious.

Referring to **claims 9-10**, the '700 reference discloses said second dopant concentration according to the embodiment of Fig. 4 and as detailed above for claim 4, and although the reference does not disclose a specific range of dopant concentrations as claimed, selecting such a range of dopant concentrations for said second dopant concentration would be within the routine skill of one of ordinary skill in the art at the time the invention was made, therefore, such selecting would have been obvious.

Referring to **claim 17**, the '700 reference discloses said first and second doped sub-regions which constitute said doped region (13) as detailed above for claim 4, wherein said doped region is doped with said first conductivity, which is p-type, as detailed above for claim 2; and although the reference does not disclose that said doped region, or specifically said first and second doped sub-regions which constitute said doped region comprises BF_2 or Indium ions, using BF2, for example, for forming said p-type was a known and available procedure.

Referring to **claim 18**, as noted above for claim 1, said doped region and said charge accumulation region are part of a photodiode.

Referring to **claims 36-37**, the reference discloses said first dopant concentration according to the embodiment of Fig. 3 and as detailed above for claim 35, and although the reference does not disclose a specific range of dopant concentrations as claimed, selecting such a range of dopant concentrations for said first dopant concentration would be within the routine skill of one of ordinary skill in the art at the time the invention was made, therefore, such selecting would have been obvious.

Referring to **claim 40**, the reference discloses said first region (13) which is doped with said first conductivity type and which is generally called said first doped region as claimed and as detailed above for claim 30, wherein said doped region is doped with said first conductivity, which is p-type, as detailed above for claim 31; and although the reference does not disclose that said first doped region comprises BF_2 or Indium ions, using BF2, for example, for forming said p-type was a known and available procedure.

7. **Claim 25** is rejected under 35 U.S.C. §103(a) as being unpatentable over Sin U.S. Patent 5,962,882 (the '882 reference, cited in a previous office action).

The reference discloses said charge accumulation region as detailed above for claim 1, wherein said charge accumulation region is doped with said second conductivity, which is n-type, as detailed above for claim 2; and although the reference does not disclose that said charge accumulation region comprises arsenic, antimony, or phosphorus ions, using arsenic, for

example, for forming said n-type was a known and available procedure at the time the invention was made.

8. **Claims 22-23** are rejected under 35 U.S.C. §103(a) as being unpatentable over Sin U.S. Patent 5,962,882 (the '882 reference, cited in a previous office action) in view of Nagata et al. U.S. Patent 6,407,417.

The '882 reference discloses a photoconversion device substantially as claimed and as detailed above for claim 1. The reference further discloses that said photoconversion device is part of a CCD imager as detailed above for claim 24. However, the reference does not teach that said imager could be formed in a CMOS process, which would result in a device that is part of a CMOS imager as claimed. The reference thus further does not teach that said would-be CMOS imager is a 3T, 4T, 5T, 6T, or 7T device (where T is transistors).

Nagata, in also disclosing a photoconversion device, teaches that a CMOS imager offer a few advantages over a CCD imager such as lower power consumption and ease of logic implementation (col. 1, lines 25-67).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form the reference's device such that it is part of a CMOS imager instead of a part of a CCD imager. One would have been motivated to make such a change in view of the teachings in Nagata that a photoconversion device that it is part of a CMOS imager instead of a part of a CCD imager results in lower power consumption.

As for the limitation 3T, 4T, 5T, 6T, or 7T device (where T is transistors), it would have been obvious to one of ordinary skill in the art at the time the invention was made to add more T for the purpose of controlling the photoconversion device as the need arises.

9. **Claim 45** is rejected under 35 U.S.C. §103(a) as being unpatentable over Mori et al. U.S. Patent 6,521,925 (the '925 reference).

The reference discloses a photoconversion device as claimed and as detailed above for claim 30, and further discloses that said photoconversion device may be part of a CCD imager (col. 12, lines 65-67).

Allowable Subject Matter

10. Claims 11, 13-14, and 48-50 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is an examiner's statement of reasons for the indication of allowable subject matter: The cited art, whether taken singularly or in combination, especially when all limitations are considered within the claimed specific combination, fails to teach or render obvious a photoconversion device having all exclusive limitations as recited in claims 11, 13, or 48.

Conclusion

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tu-Tu Ho whose telephone number is (571) 272-1778. The examiner can normally be reached on 7:30 am - 6:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, DAVID NELMS can be reached on (571) 272-1787. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Tu-Tu Ho
May 03, 2006